"Will not Doña Agnes deign to select something from among my gifts?"

A permissive nod from her lady mother, and Agnes was soon turning over the mixed heap of jewels and superstitious rubbish—her eye almost instantly fell on the little white shell. Neglecting all the princely gems and the priceless relics of saving virtue collected there, with a hasty glance of intelligent recognition at the earnest and handsome face which was also bending over her and them, her hand closed upon the most precious souvenir she could see—a small, white token, once taken from the broad basin of her father's fountain. Then turning slightly to avoid observation, she touched a spring in the broad jewelled handle of her fan, and quickly laid its mate in Francisco's hand.

His object for that day was accomplished; his child-love had recognized the tie as still binding, and he was happy. Proud and happy, for he knew that his fame had come before him. It was not alone that success had crowned the labors of his pencil, and that comparative wealth was certainly within his reach, but that young as he was, he was already selected for eminent distinction at his native court. John V. was redecorating the royal palace at Mafra, and he had desired the Marquis of Abrantes to send him speedily, or bring with him, Francisco Vieira, the young artist, of whom all his court were talking as the fittest person to furnish the principal designs.

Is it wonderful, then, that the young lover approached the mansion of his earliest patron with something akin to confidence—that he passed under the sculptured arms upon the arched gateway without a feeling of inferiority—that he dared, with the ardent hopefulness of youth and prosperity, to anticipate a blissful fulfillment of his golden dreams?

(To be continued.)

None but smatterers in Art ever estimate the value of a work by the rule of its dimensions; the man of true taste only looks at the mind displayed in the production, not at the extent of surface over which its result may be diffused. The feeling which induces the pretender to taste to slight the genius embodied within the small compass of the antique gem, merely on account of its minuteness, is the same in its nature as that which has prompted all races, as well at the dawn as at the decline of the fine arts, to erect monuments which aim at producing effect by their magnitude alone. Pausanias observes satirically that "only Romans and Rhodians pride themselves upon the possession of colossi," whilst the masterpieces of Greek skill rarely exceeded the size of life.—*King.*

THE WATER SUPPLY OF ROME IN TRAJAN'S TIME.

Translated by Theodore Weston, *from a report made by the "Prefect of the Seine,"* G. E. Haussmann, *to the Municipal Board of Paris, July,* 1858.

To secure an abundance of pure water, and to distribute it with regularity and constancy through all the quarters of a large city, has ever been esteemed of the utmost consequence, and works, therefore, constructed for this purpose, have justly been regarded as among the most important acts of illustrious rulers, and invariably hold a lasting place in the gratitude of mankind.

The foundations of nearly every great city have been commenced on the banks of some river, the first inhabitants supplying themselves from the stream; but as population has increased, people have been forced to build their houses away from the shore, and finding no good water in their neighborhood without sinking wells, they have been obliged to use these, readily reaching the subterranean sheet a few feet below the surface, water in most cases distributing itself freely through valleys and low grounds; the city, however, continuing to expand, and the inhabitants compelled to locate on higher grounds, obstacles presented themselves in boring to a waterbed at such an increased depth, and it being discovered, too, that a dense population, by the unavoidable accumulation of refuse about their closely packed dwellings, spoiled the wells, and even tainted the stream, the necessity of conducting the neighboring springs and brooks into the city became apparent; and so, as this want increased, the more remote streams. Such has been the common experience of the oldest and most celebrated towns.

Without stopping to notice the aqueducts in Egypt, Palestine and Greece, that have been recorded and described by historians, the remains of which, in numerous instances, are still to be seen, I cannot silently pass over the great works of this nature which have been carried out by the enterprise of the Romans.

Through Europe, and parts of Asia and Africa, are these aqueducts scattered; some yet standing, despite the shocks and changes of many centuries, still supplying with unfailing constancy the grateful abundance of their waters to all their old localities. Others, in various countries, are now nothing more than sublime ruins, their majestic proportions and imperishable remains serving but to record the grandeur of the people who constructed them.

If we may judge the perfection of a nation's refinement by the varied, liberal and luxurious

use of water, and by the skill and power its people display in procuring it, we must, without doubt, regard the Romans as superior not only to all ancient, but, indeed, to all modern nations; for, viewed in this light, old Rome has for a long time excited the envy of cities which to-day boast a denser population, a better municipal organization, and a higher degree of excellence both in art and manners.

Located on the banks of the Tiber, which runs nearly south, at a short distance above its confluence with the Anio, coming down from the east, Rome spreads over the last of those little eminences belonging to a chain of hills which constitutes the southwest boundary of the basin of the Anio. At the end of the first century of our era, during the reigns of Nerva and Trajan, an immense volume of water was furnished to the city, collected and brought in from nine distinct sources, and distributed at different levels throughout her various quarters. Six of these sources, named *Appia*, *Marcia*, *Aqua Virgo*, *Claudia*, *Anio Vetus* and *Anio Novus*, were located in the valley of the Anio. Two others, called *Tepula* and *Julia*, appropriate the head waters of certain small tributaries which join the Tiber on its eastern bank, not far below the city; and the last, *Alsietina*, which tapped the lake of that name, was situated on the right bank of the river, and to the northwest of Rome.

These aqueducts of masonry stretched across the mountains or followed the slopes of the hills, sometimes buried far underground, and sometimes supported by high embankments. In crossing valleys the uniformity of their grades was never disturbed, nor was advantage taken of syphons, which, though economical, yet sacrifice the effective head of the waterflow; but at such places rows of stately arches were constructed, rising sometimes as high as 108 feet, and having spans of more than 26 feet in width. Occasionally, two or three of the different lines met, and were then carried over on the same structure, as, for instance, the *Julia*, *Tepula* and *Marcia*, which were built one on top of the other, the respective levels of their streams being carefully preserved. Most of the aqueducts, however (all, in fact, on the left bank of the Tiber except the *Aqua Virgo*), in approaching Rome, followed a long slope parallel to the *Via Appia*, and discharged into huge reservoirs, where the water was allowed to settle before it was distributed through the great city. The *Anio Vetus* and *Anio Novus*, which drew their supplies from sources still more turgid, also discharged into a similar reservoir outside.

These aqueducts varied in length, from 14¼ to 56½ miles, the united length amounting to 260 miles, of which 226 were tunnelled or covered underground, 2⅘ on embankments, and about 31⅓ miles on arches. Where they entered Rome, the water surface of the lowest was somewhat more than 26 feet above the quay of the Tiber, making it about 72 feet above the level of the sea, while the three highest were respectively 124½, 128 and 154 feet above the quay of the Tiber, or 170½, 174 and 200 feet above the sea, the last named being nearly 10 feet higher than the highest hill in Rome.

From the settling basins the water was carried from hill to hill, through the various quarters of the city by a system of pipes, sometimes buried, but often supported on arches, and after being divided into 247 distinct reservoirs or water stations, was thence distributed by a large number of carefully measured pipes, branching off by separate orifices from the reservoirs, and running directly to the intended point of delivery, consisting principally of the gardens, palaces, fishponds of the noblemen, soldiers' barracks, baths, *thermæ*, *naumachiæ* * theatres, public fountains and sewers.

The volume of water thus furnished was enormous. The superintendent under Nerva and Trajan,† Sextus Julius Frontinus, a man of consular rank, and who was esteemed a thorough officer, as well as a reliable and straightforward writer, basing his calculations upon the statements furnished by his predecessors, declares, in one of his *Commentaries*, that these aërial rivers discharged into their reservoirs on the seven hills 410,547,000 gallons during the twenty-four hours: an amount nearly equal to nine times the total delivery of the canal *de l' Ourcq*, or almost as much as the whole flow of the river Marne where it empties into the Seine.

It is pretty difficult to determine the exact population of Rome at this period, and in default of any very precise information to be obtained from ancient records, modern research hazards various estimates. Gibbon, grounding his calculations upon several assumptions, sets it down at 1,200,000. M. Moreau de Jonnès, in his "*Statistique des peuples anciens*," makes it out much the same. M. Latarouilly, author of a book on Roman architecture, upon still different authority, reckons it at 820,000. M. Dureau de la Malle, who discusses the question with a great deal of

* *Naumachiæ* were artificial lakes, where the emperors were accustomed to exhibit sham naval engagements. The principal one was constructed in the reign of Augustus.

† Trajan's reign lasted until A.D. 117.

intelligence in his treatise on the "Political Economy of the Romans," thinks, however, that the city could not have contained more than 562,000 souls, even including the regular garrisons of soldiers in barracks, as well as the strangers who might be visiting the city. In comparing these estimates with the amount given above of 410,547,000 gallons, it follows at the highest estimate of population, that the old Roman aqueducts gave each inhabitant 342 gallons of water per day, that the average rate gave them each 500 gallons, and the lowest 730 gallons.

This water, introduced on so generous a scale, was distributed with singular care and judgment. Each considerable reservoir received the flow of two pipes, so that in case one gave out, the other might keep up the permanent service. Trajan classed these waters according to the relative degree of purity each possessed. The clearest, which came from the aqueduct *Marcia*, was used exclusively for drinking and cooking; the others were devoted to various purposes, depending upon their general value, their abundance, and their head. That which came from the river Anio itself, for instance, being almost always muddy, was used for irrigating gardens, flushing sewers, etc., while the *Alsietina*, which was still more turgid, was rarely disturbed, answering principally for the naumachia of Augustus; indeed, for a long time it was used in no way, except as supplementary, when the better water on the right bank of the Tiber began to fail in supplying the other side.

An inclosed space running entirely around the aqueducts protected them from injury or abuse. Fines, which in some cases ran up as high as $4,600 of our money were inflicted upon persons caught wasting the water or interfering with the works. The right of the citizen, however, to water intended for public use, was regarded as indefeasible. The Emperor Zeno, anticipating the subsequent action of our own kings, declared every imperial rescript or monopoly given to private individuals at the expense of the public estate, to be null and void, unless a very long possession and use established the right of the individual over the rights of the city. The decree of Charles VI., of the 9th of October, 1392, is to the same intent.

Pliny speaks with great admiration of the grandeur of these works, under the reign of Trajan. He describes the long rows of arches bearing an incredible volume of water into Rome; the mountains cut through, the rocks tunnelled, and the valleys crossed, and he declares them, in fact, to be the most marvellous works in the world.

Four centuries later, in the time of Theoderic, the governor of the city, Cassiodorus, wishing to impress upon the superintendents of these works a high idea of the importance of their duties, speaks after this fashion: "In judging of the great structures of Rome, no one need hesitate in his choice, but distinction must be made between those the value of which consists in their usefulness, and those which are merely conspicuous for their beauty. The Forum of Trajan is a marvel which you are daily accustomed to see, the Capitoline gate is a model of human skill; but they give you neither health nor the comforts of life; it is the aqueducts built with such admirable care, and bringing you such wholesome waters, that yield you these. The rivers which flow along on these hills built for them, seem almost to have their channels cut through the hardest rocks by nature, and as if they were destined forever to resist the impetuous tides of their currents. The mountain-sides themselves may give way, and the beds of the streams be dried up, but these glorious works of our ancestors must not be allowed to perish, while a little energy and care may be devoted to their preservation."

This is rather high-flown language, as was common in the days of the Lower Empire, but it gives a true idea of the feeling of the people regarding them.

And we may add, that to-day, in the face of all changes, the city of Rome still uses these old aqueducts, restored, uncovered or repaired by the energy of the sovereign pontiffs. The *Eau Vierge* (the old *Aqua Virgo*) is still standing under the same name. The *Eau Felice*, due to Pope Sixtus V., flows over the arches of the *Claudia* and *Marcia*. The *Eau Paola*, built by order of Paul V., coming from Lake Bracciano, and taking in certain springs on the right bank of the Tiber, makes use of the old *Alsietina* aqueduct, wherever it can be conveniently appropriated. These three lines give a total of more than 49,653,000 gallons for a population which now does not exceed 170,000, amounting, therefore, to 292 gallons per head.

The aggregate length of the present aqueducts is $62\frac{7}{10}$ miles. The *Eau Vierge* comes into Rome at an elevation of 72 feet above the sea, the *Eau Felice* at 190 feet, and the *Eau Paola* at 249 feet. There are eleven gate houses, or stations, whence, as in the days of old Rome, the pipes for special distribution branch off. There are 50 monumental fountains, among which the

beautiful basin of Trevi, and superb clustering jets of the Sextus and Paulus must be ranked first. Besides these there are 37 public fountains supplied by the three aqueducts, and which are kept constantly running day and night. No house of any importance is without a separate supply. Everywhere, in the courts, at the entrances and in the gardens, a generous stream of fresh water gushes out from some mouth of bronze and falls into an old marble sarcophagus, which answers for a basin, or else simply finds its way through the orifice of a pipe which is never closed. Many other lines of aqueduct, covered up in the earth, both in the environs of Rome and in the city itself, still remain perfect, their sources perhaps forgotten, and the clear water running to waste in some buried channel. The fortunate inhabitants who may happen to live near any of them, in sinking their wells, are delighted to discover so inestimable a treasure hidden by the old Romans, and preserved till our time without showing itself through the surface.

Without doubt, the governments of all the principal modern cities would do well to take old Rome, or even Rome of the present day, as their model in these particulars. In the time of the Curator Frontinus, the volume delivered by the aqueducts was very considerably diminished before it entered Rome proper, by large supplies, partly taken in the city for the purpose of adding to the splendor of the imperial palaces, and partly given to the 1830 sumptuous villas which constituted so striking a feature of her environs. The mass of the people, however, were served by quite a large number of fountains and *thermæ*, and, indeed, at establishments of all kinds which were appropriated to their necessities or their pleasures, giving them, therefore, the benefits of such an abundance as put to shame the meagre supply of cities in other respects actually better provided. Rome of our time, while devoting almost as large a proportion to the magnificence of the city, yet none the less provides for private needs abundantly and even profusely.

It may be remarked, in addition to the above interesting extract from M. Haussmann's report, that the Romans, up to the year 441 from the foundation of the city, contented themselves with the muddy waters of the Tiber, using beside occasional wells and cisterns for ordinary domestic purposes; but finding it difficult and expensive to supply any public fountains with clear and fresh water from either of the above sources, the Tiber after heavy rains becoming turgid and yellow, and the cisterns getting foul in hot weather, the Censors Appius Claudius and Caius Plautius, recommended in that year a line of aqueduct about eleven miles long which should bring into the city a sufficient supply for the general requirements of health and comfort. The *Anio Vetus* was the result of this recommendation. The water thus obtained was turned into several fountains which had been built and used sometime before and fed from cisterns; one named *Juturnus*, located on the Forum, another near an altar to the goddess of marriage, in a quarter of the city called *Vicus Jugarius*, and still another in front of the Capenian gate were arranged to receive their supplies from this new source.

The actual number of aqueducts in the time of Frontinus's supervision was ten instead of nine. This tenth one, however, which was called *Augusta*, having been built by the Emperor Augustus, was simply supplementary; it collected a number of fine fresh springs and emptied them into the Marcian aqueduct; it was only used, therefore, in the hot months, when the *Marcia* began to fail. After Trajan's reign several others were constructed, so that in Justinian's time they amounted to fourteen in all. The four additional ones were named *Antonina*, *Severiana*, *Septimiana* and *Alexandrina*. Procopius tells us that at this period there were 815 public baths, 1352 large open basins or reservoirs, 15 *nymphæ* or show fountains, and 6 large lakes for naval exhibitions.

The common belief that the old Romans were ignorant of the principle of the syphon hardly needs contradiction now—in fact, their engineers often applied it. The three aqueducts at Lyons, and especially that of Mont Pila, afford remarkable examples of its use. This last was built by order of the Emperor Claudius, who was born at Lyons, and it was intended to supply the gardens of the imperial palace. The waters of Mont Pila, collected not far from *St. Etienne en Forez*, lying to the southwest of Lyons, before reaching the city, had to be taken across several valleys of greater or less depth; over three of these depressions arches were carried, the conduit having a gentle grade sufficient to give the water a tolerably rapid current; but in crossing three others, syphons were employed. The bottom of the main valley, that of Izeron, was more than 320 feet below the surface of the aqueduct line, and the expense of arching such a chasm would of course have been enormous. Twelve syphons were used, therefore, to carry the water over. They consisted of lead pipes of about 8 inches

diameter, starting from a reservoir in which the aqueduct terminated on one side, and which were laid down the slope of the hill incased in masonry till they came to within about 38 feet of the bottom of the ravine, across which they were supported by a series of small arches, and thence taken up the opposite slope, discharging into another reservoir, from which the aqueduct started again. A number of these old pipes have been exhumed, and invariably found to be stamped with the initials TI, CL, CAES (Tiberius, Claudius, Cæsar). The old aqueduct of Coutance, of Roman construction, is another instance of the use of the syphon. But did none of these examples exist, the whole system of water distribution in old Rome is a mere elaboration of this law of fluid motion. Many tons of lead pipes of various dimensions have been taken out from the excavations of Pompeii. They seemed to have been used in house service quite as commonly as in the present day, and plumbing in Rome and Pompeii shows far more creditable workmanship than much that we are obliged to acknowledge and suffer from. All the ordinary appliances and conveniences belonging to a well-understood trade are evident from these relics; the Pompeian turn-cocks were quite as good as our own, and far more sightly, oftentimes, indeed, beautiful works of art in themselves. Excellent earthenware pipes were also extensively used where the pressure of the water was not too excessive; and sometimes in the establishments of the emperors silver ones were laid through the palaces. Macænas had such in his beautiful gardens, and the baths of Caracalla were provided with pipes of the same extravagant material.

The lead pipes of the Romans were not drawn into tubes, as we make them, but were formed by layers of sheet lead bent round a bar or core and soldered together, then successive layers added on the exterior till the requisite thickness and strength was attained.

Evidence of careful calculation, both in the making and use of pipes and construction of their aqueducts is very constantly forced upon one's attention in the study of Roman hydraulic practice. The grades of the aqueducts are beautifully uniform, and show that the Roman engineers both possessed and used very delicate and excellent instruments in the erection of their structures.

I may mention that I have reduced the measures used in the above translation to the New York standard; the gallon is the ordinary New York gallon of 231 cubic inches, and the measures of length are the common feet, inches, miles, etc.

ARCHITECTURE AS A FINE ART.

A paper by CHARLES D. GAMBRILL, *read before the American Institute of Architects.*

PAINTING — Poetry — Sculpture: Poetry — Sculpture — Painting: Sculpture — Painting — Poetry: "These three"—but which is the greatest of these is manifestly a difficult problem to solve, from the multifarious methods employed in arranging the terms by those who have occasion to refer to the fine arts in the pulpit, on the rostrum, or on the written page. According to the mysterious prejudices of the individual taste, either of the combinations with which I began, or any other possible arrangement of those words—alphabetically, chronologically, or capriciously—is employed to designate the fine arts in their whole range, and in their appropriate rank.

It is not my intention to discuss this point, but the fact which I wish you to observe, and which has often piqued my professional vanity, is this—that in all of these enumerations, *Architecture*, the noblest of all, and the mother, motive and protectress of the other arts, is entirely ignored. I crown architecture with this triple diadem, because it was of necessity the first of the arts, and may be assumed to occupy these relations to the other arts, in spite of Winklemann's remark, that "The arts of sculpture and painting attained among the Greeks a certain excellence earlier than architecture, because the latter has in it more of the ideal than the former; it cannot be an imitation of anything actual, and must, therefore, of necessity, be based on the general principles and rules of proportion. The two former, which originated in mere imitation, found all the requisite rules determined in man, whereas architecture was obliged to discover its own rules by repeated trials, and establish them by general approval."

Now, I presume to declare, and hope to show, that the order should be—*Architecture*, painting, sculpture and poetry—*these four*; and that the greatest of these is architecture; arranging the last three, *the daughters*, as you will.

And in the first place, with all due modesty, and with proper regard to the public opinion, or rather, *ignorance* of the matter, we must establish the right for architecture to be considered a fine art, and its professors, artists. I may venture to make the assertion *here*, though my presumption would be hailed with ridicule by the profane horde which condescendingly styles itself our